tions organised expeditions to the native haunts of the reindeer, where in one or two days more than 100 head were killed, and the greater number of them allowed to lie and rot on the ground. The author further gives a long list of birds which are threatened with extinction unless something is done for their preservation. The dangers to which Naturdenkmäler are exposed through the drainage and reclamation of lands, utilisation of water-power, stone-quarries, exploitation of moors for peat, &c., also the dangers of scientific forestry, leading to the disappearance of all the virgin forest, the uprooting of certain plants for commercial purposes, trapping of birds for cages, and collecting by ornithologists, are too numerous to mention in detail.

Around the ever-increasing centres of industry in Germany the pollution of air and water is becoming greater every day, with the result that plant and animal communities, as well as the whole natural landscape, are undergoing a rapid and radical change, which is necessarily accompanied by the disappearance of rare and valuable Naturdenkmäler. The proposals put forward by the author for their preservation occupy the larger part of the book. Generally speaking, they fall into three groups, viz.:—making a record of the various Naturdenkmäler for the different States throughout the Empire; providing for their protection in the various places; and making them generally known. In carrying out these proposals, it is necessary that the Government should take an active part by the passing of certain laws and allowing the active cooperation of different officials in the various departments. Also communities, societies, and private individuals are called upon to lend their aid. The various details in this proposed organisation for the protection of nature's "monuments" seem quite reasonable and eminently practical, but with laudable modesty the author does not insist that they should be accepted in their entirety. He puts them forward more as a working basis, the details of which may be subject to alteration from time to time as experience and trial should suggest. He is, however, confident that the time will come when the "monuments" of nature will receive the same care and reverence as that which has for long been bestowed upon the monuments of early art and civilisation.

PRINCIPLES OF FUEL COMBUSTION.

Smoke Prevention and Fuel Economy. By Wm. H. Booth and John B. C. Kershaw. Pp. 194. (London: Archibald Constable and Co., Ltd., 1904.) Price 6*s.* net.

IN the preface the authors state their object to be the "bringing before the fuel using public the principles of fuel combustion," more especially in relation to the smoke question and the economic use of fuel. They express their belief in the possibility of burning bituminous coal perfectly, and that black smoke is merely so much evidence of improper design. "Both on humanitarian and economic grounds its suppression is called for."

The general principles are clearly stated, and a brief description of selected types of furnace arrangement, stokers, &c., illustrated by good diagrams, makes the whole a useful compilation. It cannot be claimed that any addition has been made to our general knowledge of the subject, for the importance of proper air supply, perfect mixing of the gases and air for combustion, the maintenance of a sufficiently high temperature for unchecked combustion, and other points have long been recognised in books dealing with boiler management. Smoke, in fact, is possibly not so much the result of ignorance as of conservatism and false economy.

The book contains many statements in reference to water-tube boilers which few who have had practical knowledge of their working will altogether agree with. Thus "when moderately worked, some degree of safety, or at least a danger much less than attached to the discarded Howard boiler." Surely the rapid adoption of boilers of this type in the large electric lighting and power stations, engineering works, &c., is a sufficient answer to this.

After a reference to the development and satisfactory working of water-tube boilers with anthracite coals in America, the authors refer to the same boilers being erected in this country to burn bituminous coal, and "being set exactly as in America, the results have been hopelesly bad, *and the present smoke of London is due to this boiler more than anything else*" (p. 19). It cannot be denied that the total sum paid in fines for permitting smoke from steam plant of this type has been fairly large, but does the total number of water-tube boilers in London, many of them giving grand results, bear any large proportion to boilers of the old pattern, in spite of the rapid adoption of the former in recent years? The statement we print in italics is far too sweeping and altogether unjustified.

As the authors point out, in many cases boilers, presumably those in which the tubes are more nearly horizontal than vertical, were often set too near the fire, so that combustion was checked by the chilling action of the tubes; but this certainly does not apply to another type of water-tube boiler in use where the tubes are more nearly vertical than horizontal, for here ample combustion space is provided. Several excellent furnace arrangements are described and illustrated which provide for the maintenance of a high temperature until combustion is complete with these boilers, including the excellent one due to Mr. Miller. Engineers, however, do not seem very favourably disposed to much firebrick in the furnace, for it is not easy to ensure its standing the high temperature for any length of time, and water-tube boiler makers rather fight shy of such arrangements owing to the excessive heating of the lower tiers of tubes.

Closely connected with this question is that of the chain grate. As mentioned by the authors, this practically fell into disuse until the advent of the water-tube boiler resuscitated it, and yet we find the statement "it (the chain grate) must fail under the straight ascending flow of the usual setting of the water-tube boiler." Everything turns on the *usual* setting. There must be a number of unusual settings about, or it is not easy to understand why this grate has been so extensively adopted for these boilers. Certain it is

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that with no further elaboration of the furnace than a short firebrick arch at the fore-part (illustrated in Fig. 15) they will perform their work very efficiently, and with practically no smoke when using a bituminous coal.

A chapter is devoted to the chemistry of the combustion process. In referring to the hydrogen in fuels, the statement occurs, " it is generally assumed to be present combined with carbon to form hydrocarbons. The most important of these for the fuel user are —methane, ethylene and acetylene." A small amount of at least the first may be present in coal, but are we to assume the authors to mean that these are the important hydrocarbons existing in the coal before it has been heated?

In view of Bone's work (mentioned in a short footnote) it is a pity the authors did not revise their theory to account for the formation of smoke, seeing that the book was not published until a twelvemonth after Bone and Wheeler's paper appeared in the *Journal* of the Chemical Society (August, 1903), and Armstrong's paper in the same number, in which it is definitely stated " neither hydrogen nor carbon being burnt preferentially." J. S. S. B.

SCHOOL MATHEMATICS.

New School Arithmetic. Part ii. By Charles Pendlebury, assisted by F. E. Robinson. Pp. vi+207 to 468+xliv. (London: George Bell and Sons, 1904.) Price 2*s.* 6*d.*

New School Arithmetic. By Charles Pendlebury, assisted by F. E. Robinson. Pp. xvii+468+xliv. (London: George Bell and Sons, 1904.) Price 4*s.* 6*d.*

New School Examples in Arithmetic. By C. Pendlebury, assisted by F. E. Robinson. Pp. xiii+223+xliv. (London: George Bell and Sons, 1904.) Price 3*s.*

A School Geometry. Part vi. By H. S. Hall and F. H. Stevens. Pp. iv+347 to 442+iv. (London: Macmillan and Co., Ltd., 1904.) Price 1*s.* 6*d.*

Theoretical Geometry for Beginners. Part iv. By C. H. Allcock. Pp. 224. (London: Macmillan and Co., Ltd., 1904.) Price 1*s.* 6*d.*

Elementary Plane Geometry. By V. M. Turnbull. Pp. vi+136. (London: Blackie and Son, Ltd., 1904.) Price 2*s.*

Mathematical Problem Papers. By the Rev. E. M. Radford. Pp. vi+203. (Cambridge: University Press, 1904.) Price 4*s.* 6*d.* net.

PART II. of Messrs. Pendlebury and Robinson's " New School Arithmetic " has followed quickly on the publication of part i., and this excellent text-book is now complete. The second part is concerned mainly with the application of arithmetic to the transactions of commerce, dealing with such subjects as interest, discount, commission, stocks and shares, profit and loss, &c. Ratio and proportion find a place, and they are illustrated largely by this class of problem. The authors devote a little space to the training of youths in computations suitable to experimental work in the laboratory. Thus we find that algebraical symbols are freely introduced, and chapters are given on averages, approximations, graphs, elementary mensuration, and logarithms. This portion of the book might well have been extended even at the expense, if necessary, of some of the chapters relating to purely business matters. But the subjects treated are very numerous, affording considerable ground for selection, and many teachers will no doubt, and with advantage, omit some of the technical commercial chapters. At every stage examples are introduced in great abundance, the answers to which extend to nearly fifty pages. The book concludes with a collection of test papers, and a large number of miscellaneous problems. Parts i. and ii. are published separately, and also in one volume. The examples and answers may also be obtained without the other text. Altogether the book is one that deserves, and will no doubt obtain, an extended circulation.

With the issue of part vi. of Messrs. Hall and Stevens's " School Geometry," this popular text-book must now be nearing its completion. The present section corresponds, substantially, with Euclid, Book xi., 1–21, and it further deals with the mensuration of the simpler geometrical solids. In establishing the theorems of pure solid geometry, the authors follow Euclid rather closely, but there are some useful additions. Thus it is shown how a point in space is located by means of rectangular coordinates; but it is not shown how position and form may be exhibited graphically by means of projections. In dealing with areas and volumes, elementary trigonometry is used. The prismoidal formula is also introduced, but its value is scarcely made sufficiently manifest, and it is not shown how to deal approximately with irregularly shaped figures, by means of Simpson's or other rules. The book is printed in very distinct type, and the figures and diagrams are beautifully designed and executed. The subject-matter is presented and developed in the clear and attractive style which is always found in the authors' text-books, and is illustrated by well chosen examples.

Part iv. of Mr. Allcock's " Theoretical Geometry for Beginners " treats, in the first instance, of ratio and proportion, with geometrical applications. The propositions correspond roughly with Euclid, Book vi., but the style of proof is different. The reader is first introduced to the conception of ratio and proportion by means of numerical and algebraical examples, and his knowledge of arithmetic and algebra is drawn upon in establishing some preliminary theorems, which are subsequently used in demonstrating the various theorems. The latter half of the book is devoted to modern geometry, including chapters on harmonic pencils, the complete quadrilateral, poles and polars, centres of similitude, inversion, maxima and minima, and envelopes. Some numerical examples are given at intervals, but, as the title implies, the propositions and the exercises thereon are almost entirely confined to deductive geometry, and from this point of view the treatment is eminently satisfactory. The book is got up and printed in a way that leaves nothing to be desired.

The " Elementary Plane Geometry " by Mr. Turn-

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